

# Key Result Area 3: Linking Land and Water Resource Management

*"Water is the most critical resource issue of our lifetime and our children's lifetimes. The health of our waters is the principal measure of how we live on the land."*

—Luna Leopold, Honorary Chair, Waters of Wisconsin Forum

## Desired Result

The integrated management of land and water resources to sustain the quality of life in the Basin; preserving, restoring and enhancing ecological resources while recognizing the community's social and economic relationships to these resources.



## What Does Linking Land and Water Resource Management Mean?

Water is a finite resource, one that is necessary for all life and upon which our social and economic structures are dependent. Only by linking land development and management practices with water resource considerations can we attain efficient water use and improvements in water quality. To achieve the most efficient, protective and sustainable use of those water resources, our growth and development decisions must reflect the following:

- the transient nature of water
- the interconnections of land and water
- the watershed as the natural framework for integrating water resource decisions

## What is the Importance of Linking Land and Water Resource Management?

Integrating water resource and land use management is the critical strategy for realizing improved results in our use of water and land. Linking land development and management practices with water resource considerations can help attain optimal water use and improvements in water quality.

### ***The transient nature of water connects to the land on which it falls and the soils it infiltrates.***

Our environmental protection experience has shown us that focusing on the point sources of pollution, through "end-of-the-pipe" regulations and standards, while very successful, is not enough. We now understand that to achieve and maintain water quality that is sufficient for all the uses of the Basin's waters, we must attend to the non-point sources of pollution, those diffuse sources that are distributed across the landscape. This may mean altering our development patterns and land practices to make more efficient use of water resources and to maintain the function of landscape elements that are integral to the quality and abundance of water resources.

### ***The interconnections of land and water must be incorporated into our decision-making.***

The interconnections of land and water resources have been accepted by science for decades, but quantifying some of the relationships remains a challenge. The knowledge of those interconnections, however, has not been adequately incorporated into our decision-making. As a result, we continue to make decisions that have unwanted environmental consequences.

An integrated approach to water resource management and protection recognizes that water resources function in a cyclical and dynamic system, one of constant

exchange through biological, chemical and physical processes between land and sky. These dynamic, cyclical exchanges have global patterns, but are most readily experienced and understood on a watershed basis.

**TABLE 1: EXAMPLES OF POINT SOURCES, NON-POINT SOURCES AND POTENTIAL POLLUTANTS**

<b>POINT SOURCES</b>	<b>POTENTIAL POLLUTANTS</b>
<i>Sewage Treatment Plant and Industrial Discharges</i>	<i>Toxic Chemicals, Temperature, Nutrients, Organic Pollutants</i>
<i>Piped Stormwater Discharges</i>	<i>Metals, Bacteria, Garbage, Nutrients, Sediments</i>
<b>NON-POINT SOURCES</b>	<b>POTENTIAL POLLUTANTS</b>
<i>Septic Systems</i>	<i>Nitrates, Bacteria and Viruses, Household Chemicals</i>
<i>Roads and Parking Lots</i>	<i>Temperature, Hydrocarbons and Metals</i>
<i>Lawns, Farm Fields, Recreational Fields, Construction Sites</i>	<i>Pesticides and Herbicides, Nutrients, Sediment</i>
<i>Pets and Other Animals</i>	<i>Bacteria and Viruses, Nutrients</i>

***The natural framework for integrated decision-making is the watershed.***

A watershed is the total area above a given point on a watercourse that contributes water to its flow, and includes the entire region drained by a waterway or watercourse that ultimately drains into a lake, reservoir, or bay. Watershed management means recognizing the natural boundaries of water resources, the landscape elements critical to water supply and quality and the potential disruptions that our development and use can cause. The challenge lies in incorporating the watershed unit into our community, regional and statewide decision-making structures. [For a discussion of the issue of “scale,” see: Key Result Area 1: Sustainable Use and Supply.]

Whether or not the preparation of a watershed management plan or document is achievable depends on:

- Recognizing that water resources are naturally cycled within a watershed framework
- Incorporating that watershed framework into our community, regional and statewide decision-making structures

**WHAT IS A WATERSHED COMMUNITY?**

*A watershed is the landscape that drains into a water body such as a stream or river. Unfortunately, political divides, patterns of commerce and transportation, and even groupings of similar ecological communities do not necessarily fall within watershed boundaries.*

*For the purposes of this Basin Plan, a watershed community encompasses the residents, landowners, businesses, voluntary associations and governmental units that make decisions about resources and development within a given watershed area. Members of each watershed community are both “upstream” and “downstream” stewards of their portion of the watershed.*

Ideally we would prepare a “watershed management plan” document to effectively manage water and land resources within a watershed boundary. Unfortunately, political divides, patterns of commerce and transportation, and even groupings of similar ecological communities do not fall within, but more frequently cross watershed

# Linking Land and Water Resource Management

boundaries. Given the natural and political constraints confronting the development and implementation of a watershed management plan, integrating water resource considerations into existing decision-making processes may be an efficient way to achieve the goals and outcomes of this Basin Plan.

Since the vast majority of land management decisions, both public and private, are made at the community level, this Plan suggests a focus on integrating water resource considerations at the level of the watershed community.

Communities that engage in watershed-based planning acknowledge their respective roles as “upstream” and “downstream” stewards, and participate with other communities in the watershed and with partner agencies and organizations in a unified effort to achieve sustainable use and protect water resources. Community plans and ordinances should be adopted to reflect the common watershed goals for water resource and growth management.

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## Goals for Linking Land and Water Management

- 3.1 Preserve and restore natural hydrological cycles in the Basin’s watersheds.
- 3.2 Maintain and restore the integrity and function of high value water resource landscapes.
- 3.3 Fully integrate water resource considerations into land use planning and growth management.
- 3.4 Encourage development and redevelopment in areas where growth can improve the economic viability of local communities while providing for the protection and enhancement of the water resources of the Basin; discourage development and redevelopment where it may impair water resources and their related natural resources.
- 3.5 Physically and visually emphasize and strengthen the social, historic, cultural, recreational and economic connections of communities to the Basin’s waterways.

### **GOAL 3.1: Preserve and restore natural hydrological cycles in the Basin’s watersheds.**

From absorption into the atmosphere as a gas, to the eventual recharging of lakes, streams, rivers, estuaries and aquifer systems, the natural hydrological cycle is a continuous and dynamic process in equilibrium. Human disruption alters the cycle in many ways. Mitigating these disruptions requires us to address land development practices and regulation, as well as impacts from existing development.

**Approximating natural seasonal flow regimes.** In addition to gauging water budgets on a reasonable watershed scale, as discussed in Key Result Area 1, we need to establish a desired hydrograph that reflects a natural range of variability.

**Preserving soil health for infiltration and recharge to support stream base flows and water supply.** Disturbance or removal of soil inhibits infiltration and, if the remaining soils are compacted, may even prevent recharge from reaching water supply aquifers.

**Maximizing natural vegetation.** Vegetation helps to maintain soil stability and local temperature regimes (microclimates). The removal of vegetation reduces soil stability, increasing soil erosion and sedimentation in waterways. The removal of vegetation also alters the amount of evaporated and transpired water to the atmosphere that normally occurs during photosynthesis. Loss of vegetation increases localized temperatures—the heat island effect that is further exacerbated by large amounts of paved surfaces. Not only is the protective shade of streamside vegetation lost, the stormwater runoff from paved, unshaded surfaces has a higher temperature to which native stream species may not be tolerant.

*“Experts tell us that water management is best done on a watershed or basin wide basis. This requires all who have a stake, whether in or outside government, to join in developing approaches tailored to regional needs.”*

*—Madeline Albright, Earth Day 2000 Speech, Global Water Security in the 21st Century*

***Replicating the natural timing and volume of stormwater runoff to ensure recharge volumes equal to those of natural conditions.*** We interrupt infiltration by routing runoff from paved areas directly into waterways. This can result in flooding, severe erosion, temperature and quality changes, and diminution of water availability for all other uses. Impervious cover increases the volume and magnitude of runoff from storm events, constituting a potential loss to local water availability. Stormwater management must counter the flow and recharge alterations caused by development.

- Wetlands play an important role in the water cycle and in habitat provision. Landscape preservation and stormwater management programs need to consider the water requirements to maintain wetland survival.

### **GOAL 3.2: Maintain and restore the integrity and function of high value water resource landscapes.**

Certain elements of the landscape are integral to the maintenance of water resource quality and quantity. Depending on existing local conditions, these landscape elements play specialized roles in water cycling and renewal.

***Taking inventory of landscape elements within each watershed that play a critical role in water cycling and renewal.*** High value water resource landscape elements should be identified at the watershed level. Steps to retain their hydrological function must be made where land use, development, and preservation decisions are made.

#### **WHAT ARE HIGH VALUE WATER RESOURCE LANDSCAPES?**

*Wetlands — soils, hydrology, vegetation*

*Erodable slopes — geology, soils, slope*

*Floodplains — areas subject to flooding within a waterway corridor*

*Ground water recharge areas — soils, geology*

*Headwater streams and associated drainage area*

*Potential and existing public water supply sources (surface and ground water)*

*Forested areas, especially those associated with headwaters and water supply areas*

*Water bodies and their associated riparian corridors, habitat and floodplains*

*This list is meant to be illustrative, not all-inclusive, as each watershed may contain a set of elements, or additional elements, that perform uniquely within that watershed. Each element may be defined in terms of the attributes associated with it.*

Functioning  
Riparian Wetlands



***Incorporating the location and functional importance of high value water resource areas or landscapes into natural resource inventory elements of local and county plans.*** These elements are important in the local establishment of optimal land use and density, for local and regional landscape protection efforts—such as open space planning—and for setting performance standards and management practices required for development. Community Master Plans should be revised to include the revised natural resource inventories inclusive of water resource landscapes and to reflect zoning protective of high value water resource landscapes.

***Including performance standards in local zoning and development ordinances.*** Local ordinances should incorporate plans and standards to conserve the water resource function of key landscape elements.

### **GOAL 3.3: Fully integrate water resource considerations into land use planning and growth management.**

Water resource considerations are the aspects of water resource use and protection that are related to the land use and management. They include, but may not be limited to:

# Linking Land and Water Resource Management

- Water availability and capacity of water supply systems, factoring in the need to include the protection of stressed and threatened source waters
- Availability and capacity of wastewater treatment
- Stormwater management measures needed to preserve and restore natural hydrological function within each watershed
- Protection or enhancement of the capacity of hydrological systems to assimilate point and non-point sources of pollution
- Direct and indirect impacts to natural systems
- Maintenance of the function of high value water resource landscapes
- The recreation potential of waterway corridors

Water resource information should be assembled and analyzed on a watershed basis to aid discussions and decision-making for planning and permitting purposes. Water resource considerations should be integrated into the planning and growth management processes for communities and regions. Some of the concerns to be addressed include:

**Considering water supply.** Master plans, zoning and development ordinances should be consistent with the availability and capacity of local water resources. Some questions for communities to consider include: 1) Are the watershed communities dependent on surface or ground water supply? 2) To what extent is conjunctive use of ground and surface water possible? 3) Are current growth management plans and zoning realistic given water supply availability? 4) Is there a current or projected water supply deficit? 5) What options exist for enhancing water supply to support expected or desired growth and what potential impacts accompany them?

- It's also important to consider potential threats to source water supplies when re-evaluating zoning and growth management plans.

**Considering wastewater treatment.** Plans for wastewater service provision should be consistent with the growth management plans of the watershed communities and sensitive to the condition and capacity of water resources of the watershed. Decisions relating to onsite septic versus regional collection and treatment need to consider the capacity of the supply source, the capacity of the receiving water body to accept waste discharge, plans for growth into the future, and the long-term capacity of water supply sources.

Typically, water supply planning and decisions about wastewater management are undertaken separately, often because the entities supplying the service operate independently of one another, and even independently of community plans. Many utility decisions for water and wastewater supply are made through utility commissions or boards that are not connected to community planning or to other agencies with interests in provision of water services.

Failure to appropriately coordinate water provision and wastewater planning can lead to serious water resource issues. For example, in our haste to stop the pollution of our coastal waters we made decisions to construct large regional plants to treat and discharge effluent beyond the shallow bays and into the ocean. Coastal areas frequently rely on ground water for potable supply, often from confined aquifers with limited rates of recharge. Where permitted development has depended on the capacity of the regional wastewater treatment facilities and not considered the sustainability of water supply, communities have experienced water supply issues, including shortages and saltwater intrusion into freshwater supply sources.

**Respecting the assimilative capacity of hydrologic systems.** Local water bodies become the recipients of wastewater discharges and stormwater runoff. Functioning ecosystems tend to be resilient to some stresses, but only within limits. Understanding an ecosystem's natural limits and linking these to water and land management is important for wastewater and stormwater planning, and for setting realistic goals for development. Just as communities and regional agencies consider the capacity of water and wastewater treatment plants and transportation networks, they should consider the assimilative capacities of the watershed's hydrologic system. Alternatives to direct



discharge to water bodies, and the establishment of water quality-based discharge standards are tools that can be used to protect water resources.

***Considering the direct and indirect impacts to natural systems.*** Prudent planning efforts examine how water is used and the direct impacts of that use through water withdrawals, wastewater discharges, etc. Indirect impacts implicate such issues as: 1) Increases in stormwater volume and changes in quality from expanding the amount of impervious surface; 2) Water quality impacts from maintenance activities, such as the application of de-icing agents on roads and parking lots or fertilizer or pesticide applications for agricultural activities, golf courses, and other recreational fields; 3) Lowering of ground water tables and impacts to streams and wetlands that can accompany increased pumping for irrigation or for potable supply. These issues are all linked directly to land development, although they are not necessarily integrated into planning and project permitting processes.

***Know your watershed.*** Establish what is known about local conditions by compiling an environmental inventory. Our ability to accurately quantify local hydrological and ecological systems is hindered by limited data, a lack of modeling tools, and by fiscal resources. However, a complete inventory of local conditions is necessary for improving planning and decision-making. There are ample water resource concepts that are adequate for planning purposes, even if advanced models are lacking. Resources can be augmented through watershed partnerships. Watershed communities can work together, sharing the costs associated with knowledge building and protection just as they share in the benefits of a healthy watershed.

- There is a need for local planning tools that will assess alternative development scenarios.

***GOAL 3.4: Encourage development and redevelopment in areas where growth can improve the economic viability of local communities while providing for the protection and enhancement of the water resources of the Basin.***

Discourage development and redevelopment where it may impair water resources and their related natural resources. Our choices about where we develop, how we develop, and how we manage our activities on the landscape, affect the quality and availability of water resources. Smart choices for growth and development incorporate water resource protection, (emphasized in Goals 3.1, 3.2, and 3.3) and seek to use fiscal resources efficiently. They also acknowledge the historic roots of a community as well as its current and future social and cultural needs. Forces for growth and development must be channeled to provide smart choices. Governmental agencies, in partnership with private profit and non-profit organizations, can develop financial and regulatory incentives to encourage smart choices for growth, development and redevelopment that do not harm and can benefit water resources. By establishing public and private partnerships we can provide the incentives and conditions appropriate for smart choices on the watershed landscape.



An aerial view of the Schuylkill river, the Delaware River's largest tributary.

We need to enable smart choices through the following actions:

- Examine impacts and develop plans on a watershed, aquifer or regional basis
- Identify targeted areas for redevelopment to absorb growth where supporting infrastructure already exists or could be improved
- Cluster new development to provide a mix of uses and activities, minimizing transportation impacts as well as landscape alteration
- Return contaminated sites and other brownfields to productive use and remove them as a source of surface or ground water contamination

# Linking Land and Water Resource Management

- Adopt ordinances and regulations designed to protect water and support natural resources through performance standards
- Incorporate natural features as functional design elements, e.g., linking constructed and natural wetland systems for stormwater and wastewater management
- Educate policy-makers, decision-makers and developers about water resources, the benefits they provide, and their community enhancement potential
- Restore the visual and physical connections of people to the waterways at every opportunity

## **GOAL 3.5: Strengthen connections of communities and people to waterways.**

What's the connection? Waterway landscapes appeal to all of our senses. Our history and culture are tied to our waterways. Our progress as a society has depended on water for transportation, for power, for commerce, for recreation, and for poetic and artistic inspiration.

Unfortunately, many of us take water for granted, possibly because we're disconnected from it. Drinking water comes from a pipe or a bottle. Buildings, abandoned industrial sites, or the protective railings of the bridges that traverse rivers and streams and the roadways that hug their shores often block views of waterways.

Experience is education. Education and knowledge are the foundation for stewardship, the concept of responsible care-taking based on the premise that we do not own resources, but are managers and are responsible to future generations for their condition. Providing the opportunity for waterway experiences is critical not only to the stewardship of water resources, but for the maintenance of some of the best aspects of human culture.

### ***Providing the opportunity to experience our waterways.***

How we re-establish connections must be context-appropriate. We should re-establish floodplains where practical; re-establish access and visual connections where suitable, especially in association with redevelopment opportunities. In urban areas, the redevelopment of abandoned and decaying waterfront areas should include a requirement that all projects incorporate elements designed to restore our physical and sensory connections to the waterfront. Providing opportunity to experience our waterways may include commuter ferries, river walks and bike trails, boat access points, fishing piers and interpretive signage. Public lands should incorporate educational elements to extend the foundations for stewardship.



Philadelphia skyline.

We need to maintain what we have and to restore what we've lost. Without the opportunity to experience our water resources — especially for sheer enjoyment and wonder — we may remain disadvantaged, missing the inspiration of water.

## **Linking Land and Water Resources Management Summary**

Involving all aspects of water resource management, landscape management, planning and growth management, cooperation and coordination, education, and

stewardship, our success in this Key Result Area is critical. Integrating the management of land and water resources challenges us to:

- Understand the physical, chemical and biological water-land connection that defines a watershed
- Recognize the management strategy options necessary to achieve positive water resource and development outcomes
- Improve communication and planning within the watershed community
- Improve regional coordination among water resource and land use agencies
- Create public, non-profit and private partnerships
- Employ incentives to foster stewardship
- Improve our collection, analysis and distribution of water resource information
- Develop and use analytical tools for local and regional decision-making
- Commit state, regional and local entities to engage in and support growth management and resource protection on a watershed basis
- Commit financial resources to support and coordinate local and regional planning and water resource protection efforts